

JOTTINGS FROM THE BIOLOGICAL LABORATORY OF
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6. ON THE MYOLOGY OF THE FLYING PHALANGER.

(*PETAURISTA TAGUANOIDES.*)

Petaurista is a Phalanger which has undergone a modification strictly paralleled by that observable in the case of the true Flying Squirrels. A wide flap of skin extending on either side of the body between the fore and the hind limbs enables the animal, by straightening the limbs and extending the front pair forwards and the hind pair backwards, to present a broad flat surface to the air, by the parachute action of which it is enabled to fly, or rather skim, in a slanting direction from one branch to another.

An examination of the muscular system of this curious Marsupial shows that it is in all essential respects, as in fact is evidenced by the structure of the skeleton and the dentition, a very near ally of *Phalangista* and of *Cuscus*. The special modifications of the muscles connected with the act of so-called flight are very few and, with the exception perhaps of the remarkable femoro-caudal muscle, concern only the panniculus carnosus.

MUSCLES OF THE ANTERIOR EXTREMITY.

As in many other Marsupials the differentiation of the *deltoid* from the *trapezius* is incomplete—a portion of the fibres of the latter passing over the shoulder and taking the place of part of the former. In other words the anterior part of the *trapezius* in *Petaurista*, instead of stopping short at the acromion and clavicle,

passes over them to the humerus, the part of the muscle between the shoulder-girdle and the arm taking the place of the middle part of the deltoid. In *Petaurista* there is no fusion between the fibres of the trapezius and those of the clavicular part of the deltoid, and none of the fibres of the former muscle are inserted into the clavicle ; whereas in *Cuscus* (1) and to a less extent in *Phalangista* the anterior portion of the trapezius actually fuses with the deltoid, and some of the fibres of the trapezius are inserted into the clavicle. The arrangement of the humeral part of the trapezius seems to present considerable variations in other families ; it is altogether absent in the Wombat according to Macalister. (2)

The *latissimus dorsi* in *Petaurista* differs from the corresponding muscle in *Phalangista* and in *Cuscus* in being undivided at its insertion ; in the two latter genera it bifurcates to become inserted in two parts—the one part being inserted along with the *teres major*, and the other into the bicipital groove.

The humeral offset from the *panniculus carnosus* is rather more powerfully developed in *Petaurista* than in the *Phalanger* ; in the former it is inserted by a broad thin tendon into the pectoral ridge of the humerus, partly in conjunction with the insertion of the *pectoralis quartus*, but partly independently. In *Phalangista vulpina* the muscle has no independent insertion, its tendon joining that of the *pectoralis quartus*, and becoming connected also with a tendinous arch between the two insertions of the *latissimus dorsi*.

In both *Phalangista* and *Petaurista*, as in *Cuscus*, the *acromio-trachelian* consists of two parts arising from the atlas and axis, and diverging to become inserted at a considerable distance from one another—the one into the distal part of the spine of the scapula and the proximal part of the acromion, and the other into the vertebral (proximal) part of the spine.

(1) Cunningham, Reports of the Challenger Expedition, Zoology. Report on the Marsupialia, p. 3.

(2) "Myology of the Wombat and Tasmanian Devil." Ann. Mag. Nat. Hist., 4th series, Vol. V., p. 159.

The *pectorales* muscles in *Petaurista* have essentially the same arrangement as in *Phalangista* and in *Cuscus*. There is a *pectoralis major*, which consists of a large superficial part itself divisible into two, and a smaller deep part situated beneath it; a *pectoralis minor* which lies behind the deep part of the *pectoralis major*; and a long *pectoralis quartus* arising from the *linea alba* and the fascia over the *rectus abdominis*. This is an arrangement of the pectoral muscles which seems specially to characterise the present family.

In all three genera the *subclavius* is inserted wholly into the clavicle.

In *Petaurista* the *deltoid* consists of two quite separate parts, a scapular and a clavicular, separated from one another by the humeral part of the *trapezius*. In *Phalangista* also the two parts of the muscle are distinct, but, as already noticed, the relation of the *trapezius* to them is a little closer than in *Petaurista*; and the same, according to Cunningham, (1) holds of *Cuscus*. (2)

In *Cuscus* there are two coraco-brachiales; in *Phalangista* and in *Petaurista* one alone is represented. In the related genus *Phascogale* (the Koala) there are two distinct coraco-brachiales. (3)

As in *Cuscus* and *Phalangista* the *biceps flexor cubiti* consists in *Petaurista* of two parts separable throughout their length, except near the proximal end; one of these arises from the upper margin of the glenoid cavity alone, and is inserted into the coronoid process of the ulna, the other has heads of origin both from the coracoid process and the glenoid cavity, and is inserted into the bicipital tubercle of the radius.

The *epitrochleo-anconeus* seems to be of universal occurrence in the Marsupialia; it has the same form and connections in the *Petaurista* as in *Cuscus* and *Phascogale* as described by Cunningham.

(1) L. c., p. 9.

(2) The deltoid is described by Macalister as undivided in the Koala ("The Muscular Anatomy of the Koala," Ann. Mag. Nat. Hist. (4), Vol. X., p. 127), but Young ("Myology of the Koala," Journ. Anat. Phys., Vol. XVI., p. 226), describes it as consisting of two distinct parts.

(3) Young, "Myology of the Koala." (Journ. Anat. Phys., Vol. XVI.)

As usual in the Marsupialia the *supinator longus* is a powerful muscle; as in *Phalangista* and *Cuscus* it is inserted into the scaphoid.

Both radial extensors are developed in all the three genera under consideration (1). In the *Cuscus* Cunningham describes the *extensor carpi radialis brevior* as having three heads of origin, one from the outer condyle, a second from the tendinous expansion over the supinator brevis and a third from the posterior border of the radius in its proximal part. In *Petaurista* the muscle has a similar origin but derives none of its fibres directly from the radius.

The *supinator manus* (*extensor ossis metacarpi pollicis*) in all three genera is inserted into the trapezium as well as into the base of the metacarpal of the pollex.

The arrangement of the extensors of the digits of the manus is the same in *Petaurista* as in *Phalangista* and *Cuscus*. The *extensor sublimis* arising from the outer condyle as usual gives off tendons to the four ulnar digits. The *extensor profundus*, arising from the ulna, is composed of two parts; the *extensor secundi internodii pollicis* and the *extensor medii*; the latter is connected with the second and fourth toes as well as with the middle. Besides these there is an *extensor minimi digiti* which arises from the outer condyle and represents an *extensor secundus*. (2)

The *extensor carpi ulnaris* consists in *Petaurista*, as in *Phalangista* and *Cuscus*, of a single muscle.

In none of the three genera has the *pronator radii teres* a coronoid head of origin. This seems to be universally the case in Marsupials. (3)

The *flexor carpi radialis* in *Petaurista* and *Phalangista* is inserted, as in *Cuscus* into both the second and third metacarpals.

(1) Macalister describes a *single* radial extensor in the *Phalanger* as in *Macropus*, *Phascolomys* and *Sarcophilus*.

(2) Humphrey. "Observations on Myology." p. 185.

(3) Macalister. "On the Myology of the Wombat and Tasmanian Devil." Ann. Mag. Nat. Hist., 4th series Vol. V., p. 1. Young, "On the Muscular Anatomy of the Koala." Journ. Anat. Phys., Vol. XVI., p. 228.

The *palmaris longus* is a simple slender muscle in the specimens of *Petaurista* examined. It is double in the *Phalanger* in some cases; sometimes single. In the specimen of *Cuscus* dissected by Cunningham it consisted of three parts.

The *flexor carpi ulnaris* presents, as in most, though not all, Marsupials, two heads of origin; one from the internal condyle, condyle, and the other from the olecranon.

The flexor muscles of the digits in *Petaurista* and *Phalangista* as in *Cuscus*, are all more or less closely amalgamated at their origin, where they arise in a mass from the inner condyle and the proximal parts of the ventral surface of the radius and ulna. The superficial part of the common muscular mass gives off slender perforated tendons to the four ulnar digits; while the tendons from the deep part are inserted into the terminal phalanges of all the digits. This plan of arrangement of the flexor muscles of the digits seems to be very general among the marsupials. (1)

MUSCLES OF THE POSTERIOR EXTREMITY.

The *gluteus externus* consists in *Petaurista*, as in *Cuscus* and *Phalangista*, of three parts, the hindermost part being the *agitator caudæ*, the middle part the *gluteus maximus*, and the anterior part, according to Cunningham, having the nerve supply of the *tensor fasciæ femoris* of other mammals. But besides these, *Petaurista* possesses an additional muscle belonging to this series—a muscle not represented in *Phalangista* or *Cuscus*, nor, so far as I am aware, in any other Mammal. It is a ribbon-like muscle, situated on the same plane as the adductor caudæ; it arises from the seventh caudal vertebra, and, running over the biceps and semitendinosus, is inserted into the distal end of the femur on its outer aspect. A slender slip detached from it joins the *agitator caudæ*. It seems very probable that the development of this peculiar muscle is connected with the special habits of the flying phalanger; the name *long femoro-caudal* will serve to indicate its connections without implying any theory of its functions.

(1) *Vide* Macalister. L.c.

The *pyriformis* is quite a distinct muscle in *Phalangista* (as well as in *Petaurista* and in *Cucus*) and is not amalgamated with the gluteus medius as stated by Professor Macalister. (1)

The arrangement of the *biceps* described by Cunningham as obtaining in *Cucus* is almost identical with that observed in *Phalangista* and *Petaurista*. The muscle consists of an ischial part arising with the semitendinosus from the ischial tuberosity and spreading out in a triangular form distally to become inserted into the fascia of the leg; and a caudal part which arises from the transverse processes of the first two caudal vertebrae, and, after becoming closely united for a short distance with the semitendinosus, bifurcates—one part joining the ischial division of the muscle and the other becoming inserted into the inner side of the tibia. In all three genera the *bicipiti accessorius* is absent.

In *Petaurista* and *Phalangista* the *rectus femoris* has only a single head; in *Cucus* Cunningham describes a slender second head arising from the spine of the ilium. In the Koala, Macalister describes the origin as single. (2)

In *Phalangista*, as in *Cucus*, the *gracilis* has no connection with the marsupial bone. In *Petaurista* on the other hand a few fibres are derived from the base of that bone.

Cunningham describes only two *adductors* as occurring in *Cucus*—the *adductor brevis* and the *adductor magnus*: but in both *Phalangista* and *Petaurista* all three adductors are well represented.

In *Cucus* and *Phalangista* the *gastrocnemius* consists of two parts which are separable throughout, the inner part arising from the back of the internal condyle of the femur, while the outer derives its origin from the sesamoid at the head of the fibula and from the outer condyle. In *Petaurista* the muscle has the same origins, but the two halves are intimately united in the middle of the calf.

(1) "Myology of the Wombat and Tasmanian Devil," Ann. Mag. Nat. Hist. (4th series), Vol. V., p. 167.

(2) "Muscular Anatomy of the Koala." Ann. Mag. Nat. Hist. (4), X.

As in the phalanger the *plantaris* is intimately united in *Petaurista* with the deep surface of the outer head of the *gastrocnemius*. In *Cuscus* it is described by Cunningham as being quite distinct from the latter muscle. In the Koala, according to Macalister, the union is close.

The *tibialis posticus* is represented in *Petaurista*, as in *Phalangista* and *Cuscus*, by two separate muscles both inserted into the scaphoid. (1)

As in the forelimb, so also in the hind limb, the *flexor muscles of the digits* are united in all three genera into one muscular mass. This arises from the posterior surface of the fibula: the superficial part gives origin to tendons passing to the third, fourth and fifth toes; the deep part supplying tendons for all the digits including the hallux.

The *extensor longus hallucis* of the phalanger is described by Macalister as being inserted in the index as well as into the hallux, but this is certainly not the case in the specimens I have examined; in *Petaurista* also, as in *Cuscus*, the insertion is only into the terminal phalanx of the hallux.

The *extensor brevis digitorum* in *Phalangista* and *Cuscus* consists, as regards its origin, of a fibular and a pedal part, the former consisting of two slips giving tendons to the fourth and fifth toes, while the pedal part, arising from the calcaneum, ends in delicate tendons for the second and third toes. In *Petaurista* the pedal part of the muscle is not developed. (2)

(1) According to Owen (Anat. of Vert. III., 16), the *tibialis posticus* in *Phalangista vulpina* divides into two tendons which are inserted into the internal and middle cuneiforms.

(2) Owen regards the part of the fibular *extensor brevis* going to the fifth toe as an internal *peroneus*. (Anatomy and Physiology of Vertebrates, Vol. III., p. 16.)